ANNUAL REPORT

OF THE

DIRECTOR

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

FOR THE FISCAL YEAR ENDING
JUNE 30, 1923

BROOKINGS, SOUTH DAKOTA

STATE PUBLISHING CO., PIERRE

ANNUAL REPORT

Mr. C. W. Pugsley, President,
South Dakota State College,
Brookings, South Dakota.

Dear Sir:

I have the honor to make the following report of the South Dakota Agricultural Experiment Station for the fiscal year ending June 30, 1923:

Organization

There are seven departments of this station as follows: Agronomy, Animal Husbandry, Chemistry, Dairy Husbandry, Entomology, Horticulture, and Veterinary. These departments are in charge of the professor of the subject in the college. Each department head and assistant is paid in proportion to the time he works for each. By this arrangement better prepared men are employed than if each were a separate institution. Students are also benefited by the results of experiments in becoming familiar with methods used. At the close of the year there were 23 regular employees on the station force. In addition all departments employ students and others by the hour. Students learn by doing, which is a valuable line of instruction.

Object and Support

The object of the station is to conduct experiments along agricultural lines for the benefit of the producers of the state. By law, the station is a part of the agricultural college but is supported almost entirely by the $30,000 received from the federal government under the provisions of the Hatch Act of 1897 and the Adams Act of 1906.

State Appropriations

The legislature of 1922-23 made an appropriation of $20,000 for experiments in horticulture and $20,000 for experiments along livestock lines, also included the usual appropriation of $1,500 for printing popular bulletins, and in addition, appropriations for support of four sub-stations at Eureka, Highmore, Vivian, and Cottonwood.

Publications

There were four bulletins printed during the year on the following subjects:

No. 200. Winter Wheat in South Dakota. This bulletin gives the results of growing varieties of winter wheat over

a period of years at Brookings, Highmore, Eureka, and Cottonwood stations.

No. 201. Some Experiments with Spring Wheat in South Dakota. It is summarized as follows:

"If the yield of Kubanka (durum) averages 25 percent higher than the yield of Marquis (common), in areas represented by Brookings, Highmore and Eureka, the price of common wheat (hard red spring) must be something more than 25 percent higher than that of durum, in order to be as profitable to produce.

"Kota wheat yielded somewhat higher at Brookings and Highmore than Marquis in short-time trials; and Marquis yielded higher in similar trials at Eureka. Marquis is a wheat of established milling quality, and Kota is a promising wheat meriting further trial.

"Change varieties of wheat conservatively. A good variety is as likely to continue good as a new and untried variety to prove good. For instance, Preston at Eureka yielded 7.7 bushels per acre as an average the first 7 years and 10.3 bushels per acre the following 7 years. Apparently, the variety did not 'run out.'

"Seed seasonably early. At Highmore the almost unfailing indication is that seeding wheat should proceed in March. The early seeded wheat gets the yield.

"Increasing the amount of seed sown per acre from 2 pecks per acre to 7 pecks per acre at Brookings produced the highest average yield for the thickest seeding mentioned.

"Sow 7 pecks per acre in Highmore area, whether common wheat or durum.

"The best depth of seeding is sufficient to make a complete covering for the seed. Wheat on a clean seed bed (e. g., wheat after corn) at the places named usually produces yields high enough to cover cost of production.

"The lowest average yields were produced by wheat where seed was merely disked in on stubble.

"To sum up, in eastern South Dakota for spring wheat, increasing emphasis should be laid upon: (1) a clean seed bed (after a cultivated crop); (2) seasonable seeding, with treated seed of a suitable variety. There is no evidence in this bulletin that a system of continuous wheat, or wheat seeded on weedy land with untreated seed will produce a profitable yield. There is evidence that such systems will produce low yields and consequent loss."

No. 202. The Chinch Bug, includes a treatise on the distinct stages of existence in its life cycle, habits, injury done, conditions favorable for outbreaks, control thru natural enemies, and by man.

No. 203. Pasteurization of Market Milk in the Glass Enameled Tank and in the Bottle. The following are the conclusions:

"The glass enameled tank when used as a complete pasteurizer and cooler for market milk had two objections. The first of these was the length of time required for cooling, which delayed the bottling of the milk. While it is true that with the in-the-bottle method used it required a still longer time for cooling, yet this was not so serious because the milk was already bottled ready for delivery. The second objection was the reduction of the volume of cream due probably to the excessive length of time required for cooling during which the milk was subjected to agitation.

"The glass enameled tank when used with a surface coil cooler gave very satisfactory results as compared with the in-the-bottle method. The rapid cooling gave a larger volume of cream and the line of demarcation was very distinct. The last milk over the cooler gave a less volume than the first over the cooler. It took about 30 or 40 minutes to finish the cooling and bottling and this meant that the last milk over the cooler was under agitation for a longer period of time. It is probably true that with other methods of in-the-bottle pasteurization cooling may be accomplished more quickly than in these experiments. If this is possible better results could no doubt be obtained as to volume of cream and distinctness of cream line.

"As far as bacterial count is concerned it is the usual impression that the in-the-bottle method gives the better results and this is the case unless special care is taken in sterilizing the cooler, bottler, etc., to which the milk is exposed after pasteurization in bulk. In our work a commercial sterilizer was used in addition to hot water and steam and the counts of the milk pasteurized in the glass tank compared very favorably with those of the milk pasteurized in-the-bottle.

"The flavor and odor was usually cleaner in the case of the milk pasteurized in the glass tank. If there are any objectionable flavors or odors present in the raw milk they have a better chance to escape when the milk is pasteurized in bulk. There was a slight heated taste in some of the milk pasteurized in the glass tank but it was not serious.

"Under the conditions of these experiments the glass enameled tank combined with a surface coil cooler is to be preferred to the in-the-bottle method for pasteurization of market milk."

There are many requests for our bulletins not only from residents of South Dakota but people in other states and foreign countries.

Agriculture is being taught in the high schools to a greater extent than ever before. In many cases the bulletins of this station are used as texts. While we do not place the names of non-residents on our regular mailing list, we send single bulletins, when supply will permit.

DEPARTMENT OF ANIMAL HUSBANDRY

The feeding of cattle, swine, and the breeding and feeding of sheep were the experiments conducted during the year.

Cattle

No. I. To determine the value of corn silage as a roughage with both corn and barley and also the value of adding a small ration of oats to these grains for the production of baby beef. For this work 42 head of Hereford calves were purchased on the range south of Ree Heights, divided into six different lots of seven head each. Each lot was given the whole grain or the mixture. At the close of the test the calves were shipped to Chicago, sold on their merits and a slaughter test secured for each.

No. II. The demand for information from the range country where barley and rye are grown, as to the value of these grains for beef production and from the fact that rye has been seldom fed as a fattening ration for cattle, prompted us to conduct an experiment along this line. A load of 2 year old native steers was purchased, locally, and divided into four lots. To Lot I was fed whole barley; Lot II ground rye; Lot III whole rye, and to Lot IV whole corn. At the end of the test the steers were shipped to Chicago and prices per lot were placed on each. Further experiments in this line will be conducted before publishing the results.

Swine

No. III. The comparative value of different forage crops for pasture for pigs.

No. IV. Summer rations for pigs while on pasture.

No. V. The value of raw and cooked potatoes for pigs.

These pig feeding experiments will be repeated before publishing results.

Sheep

No. VI. In the fall of 1922, 90 lambs were divided into nine different lots of 10 head each and placed in fields of

growing forage to determine the value of the different crops for lambs after they are weaned. The lamb at this time should have the best of care and some of the forage crops used can be grown in nearly any section of the state. This experiment will also be repeated before publishing results.

No. VII. To develop, by selection and the use of the Siberian blood, a breed of sheep with a short tail so the lambs will not need to be docked. Some progress was made in this line. A load of western ewes was divided into nine different lots for the purpose of testing the breeding power of the different selections in this respect.

No. VIII. To determine the value of the use of the Karakul ram on ewes of the purebred Siberian and also on grades of the different percent of Siberian blood with a view of combining the choice fleece of the Karakul and the hardiness and other good qualities of the Siberian. The first cross has been made and some very choice close curled fleeced lambs were secured. Lambs two months old of some of the crosses still have considerable curl to their fleeces and we believe it possible to develop a strain that would be suitable at this age for meat and also have a valuable pelt.

This department receives many inquiries for information on feeding and breeding problems which are answered promptly.

The following is the financial statement by the secretary, Mr. R. A. Larson, which is self-explanatory:

EXPERIMENT STATION AND SUBSTATIONS

Receipts 1922-1923

	Home Station Brookings	Cottonwood Substation	Eureka Substation	Highmore Substation	Vivian Substation	Miscellaneous	Total
Hatch	$ 15,000.00	$	$	$	$	$	$ 15,000.00
Adams	15,000.00	.....	.....	.....	.....	.....	15,000.00
State Appropriations	.....	3,230.00	3,230.00	3,230.00	3,230.00	1,500.00	14,420.00
Land Endowment	.....	.....	.....	.....	.....	3,497.26	3,497.26
Sales of Produce	1,512.04	253.94	639.19	602.58	1,200.84	.....	4,208.59
Balance on Hand July 1, 1922	1,225.17	.....	.....	.....	.....	5,811.43	7,036.60
Totals	$ 32,737.21	$ 3,483.94	$ 3,869.19	$ 3,832.58	$ 4,430.84	$ 10,808.69	$ 59,162.45

EXPERIMENT STATION AND SUBSTATIONS

Disbursements 1922-1923

	Hatch	Adams	Sales Fund Brookings Station	Cottonwood Substation	Eureka Substation	Highmore Substation	Vivian Substation	Bulletin	Total
Salaries	$ 8,261.58	$ 8,988.24	$.....	$2,578.22	$2,415.09	$2,392.01	$2,746.31	$.....	$27,381.45
Labor	1,463.54	4,119.79	769.13	1,708.44	1,326.74	1,317.81	1,256.38	.....	11,961.83
Publications	3,202.20	.....	.....	.....	.....	.....	.....	1,482.04	4,684.24
Postage and Stationery	34.00	106.65	24.99	24.14	34.94	13.19	11.44	.....	249.35
Freight and Express	77.98	12.47	15.19	95.79	22.27	43.50	31.49	.....	298.69
Heat, Light, Water and Power	.....	.....	.....	.....	12.00	3.72	.....	.....	15.72
Chemical and Laboratory Supplies	382.20	282.11	30.40	21.00	.....	109.23	10.10	.....	835 04
Seeds, Plants and Sundries	277.19	448.21	562.93	451.64	226.01	391.20	724.33	.....	3,081.51
Fertilizers	.....	30.00	.....	.....	15.20	.....	.....	.....	45.20
Feeding Stuffs	421.86	128.40	147.80	104.48	.....	.....	50.00	.....	852.54
Library	.....	26.49	3.40	.....	.....	.....	.....	.....	29.89
Tools and Implements	203.00	49.07	113.78	.....	126.90	25.50	.....	.....	518.25
Furniture and Fixtures	110.00	154.55	4.45	223.45	.....	.....	.....	.....	492.45
Scientific Apparatus	198.35	292.12	1.50	.....	.....	.....	.....	.....	491.97
Live Stock	.....	4.00	340.00	.....	.....	350.00	90.00	.....	734.00
Traveling Expense	139.62	302.06	.....	72.76	99.33	135.27	64.81	.....	813.85
Contingent	.....	.....	3.50	.....	6.25	.....	9.00	.....	18.75
Building and Land	228.48	55.84	31.16	726.21	87.70	3.30	108.25	.....	1,240.94
Total	$15,000.00	$15,000.00	$2,048.23	$6,006.13	$4,372.43	$4,734.73	$5,102.11	$1,482.04	$53,745.67

Popular Bulletin Reverted	$ 17 96
Balance on Hand Experiment Substation July 1, 1923	4,709.84
Balance on Hand Station Local, Home Station July 1, 1923	688.98
Grand Total	$59,162 45

For the best report of the station, I include and make a part of this report, the report of each division of the Experiment Station.

Yours truly,
JAMES W. WILSON,
Director of Agricultural Experiment Station
and Professor of Animal Husbandry.

DEPARTMENT OF AGRONOMY

Director J. W. Wilson,
South Dakota Experiment Station.
Dear Sir:

I beg leave to submit the following report for the agronomy department relative to progress in Hatch and Adams projects and experimental and research work related thereto. In the present report it will be attempted to indicate the lines of work now being carried on and progress of the same, but not to include all details which would not be possible in limited space and which also will be published in bulletin form.

ADAMS PROJECT NO. 1

A Project on the Influence of Rotation Upon the Maintenance of Soil Fertility.

This project involves the use of rotation experiments on East farm, Brookings, and also of continuous legume plots on West farm, Brookings, coupled with sampling and analysis of the soil from the several parts of these rotations. Two separate acres are devoted to rotations on East farm, each acre being cropped according to its own definite plan. Likewise each acre is divided into one-tenth acre plots which in turn receive varied applications of plant food.

Obviously this is a long time project because soil differences due to variations in rotation treatments will almost certainly appear only as a result of continuous treatment.

At the close of the present year analyses have not only been completed on the first set of samples taken from the plots, and also the second set which were taken from the plots seven years from the first samples, but also since the previous report a third series of samples have been taken and analyses of this latter set of samples are under way. Sampling and analyses, including twelve borings from each one-tenth acre plot, have been accomplished by Messrs. Hutton, Bushey, and Machlis, with some part time assistants. All determinations for all years have been recalculated by Miss Hazel Thompson, to insure accuracy.

Differences in crop yield from the various plots are very evident. Wherever applications of phosphorus are made to wheat plots in the rotation earlier maturity of the plants is indicated. The plots receiving nitrogen indicate the not usual phenomena of increased vegetative growth. It continues to be apparent that phosphorus is the limiting element in crop growth on these soils but likewise in the present season the appearance of a relative shortage of nitrogen has been noted. The average increase of 30 percent in cereal yields where phosphorus is applied as compared with plots where nothing is applied is not greatly changed but on plots receiving phosphorus and where nitrogen is added additionally the influence of the latter seems apparent.

Such are some of the more general differences that appear. Inherent soil differences are more difficult to summarize but the present indications are that such differences are appearing.

ADAMS PROJECT NO. 2

A Study of Correlations Between Certain Physical Characters of Plants and Their Capacity for Yield.

The project in question is a continuation of a project similar to the one reported in Experiment Station Bulletin No. 187. The correlation now under investigation is a study of length of wheat spike of mother plant as correlated with yield of progeny from such plants in succeeding years.

The results reported in Bulletin No. 187 indicated that under the conditions of that experiment with bluestem wheat there was very slight positive correlation in the direction of higher yield from longer spikes as compared with the shorter spikes. In the immediate progeny of the original mother heads, such correlation failed to persist in the successive generations. The longer and shorter spikes in both instances were carefully selected central spikes from the mother plants.

The present season may close a similar study of Marquis wheat which is one of the varieties of great economic importance. In the year 1919 mother plants of Marquis wheat were put out in nursery hills in order to secure mother plants themselves produced under comparable conditions. Central spikes were chosen from these mother plants and divided into two groups according to length. In 1920 nursery rows were planted from these alternately from (1) long heads and (2) short heads.

During the past fiscal year correlations have been computed between the length of mother heads and yields of progeny rows from the years 1920, 1921, and 1922. At the

present time the progeny rows of 1923 are ready to be harvested. The computations that have been made indicate that the immediate progeny of Marquis wheat also made a higher yield from long spikes than from relatively short spikes, but that this correlation did not persist.

It is a matter of scientific and practical interest to note such a conclusion. A number of experiments have indicated that there might be some correlation between size of spike or size of kernel and yielding capacity in wheat. The present results would indicate that there is some slight variation in yield due to length of spike, but that this variation is transient in character. One question would be, why does such a variation exist at all? Again, why does it fail to persist?

The general indication received would be that Marquis wheat appears to be a pure line so far as is indicated by yield and that selection for yield cannot be directly correlated with the physical appearance of length of spike. Details have been carried out by A. N. Hume and Mathew Fowlds. Computations have been made by Miss Elizabeth Brown.

ADAMS PROJECT NO. 4

A Project to Determine Definitely the Effects of Phosphorus in Different Forms on the Growth of Plants and the Effect of Sulphur in Combination with Calcium (Gypsum, Calcium Sulphate), and as Pure Sulphur on the Growth of Plants and Its Effect—The Availability of Phosphorus in Different Forms.

In connection with this project, soils in special pots have been carried through differential treatments. During the year just closed all tumbler cultures analyzed for phosphorus in 1922 were refilled. One hundred eighty-six analyses for water soluble phosphorus completed the set for each of the three cereals for 1922 preparations and for 1923 preparations.

Both series of pot cultures were planted and harvested in 1923. Photos showing the characteristic appearance of crops in all pot cultures were made.

Practically all work on Adams Project No. 4 was accomplished by Professor J. G. Hutton and student assistants. Results are not complete but indications are significant.

HATCH PROJECTS

Hatch projects include variety tests of cereals, alfalfa, potatoes, soybeans, also rotation experiments are included, which have been continued for many years. Among these are continuous wheat, continuous rye. Comparative rota-

tions include corn and small grain; likewise, corn, small grain and peas.

Another important field project includes what is called a comparative grain system and livestock system of farming. The essential difference in these two systems consists in the fact that crop residues, such as corn stover, oat straw and clover haulm are turned under directly in the grain system, while in the livestock system these residues are assumed to be first fed to livestock and then returned to the soil in the form of stable manure. Present indications are that the grain system where the residues are returned to the soil directly is gradually surpassing the comparative system, so far as yield for crops is concerned. The indications thus being that crop residues returned to the soil directly can be gradually incorporated into the soil to take effect as fertilizer.

Corn breeding studies are continuous as follows: Studies of strains of corn having a high percentage of protein and of other strains having a low percentage of protein, with a view to discovering a correlation between percentage of protein in yield of protein per acre. Analyses are made by Professor Alfred Bushey.

Studies of high ear bearing strains and low ear strains.

A comparison of systems of corn breeding.

The writer is continuing his attempt to devise the best practical system for breeding corn. Here it is attempted to secure (1) Continuous selection, (2) hybridization, and (3) introduction of new strains. Numerous principles of corn breeding are being evolved. The writer is attempting to incorporate them into a practical system for application by growers.

CEREAL BREEDING

Cereal breeding by means of head row selection and also hybridization is continued by Mr. Mathew Fowlds. Among the most practical results of cereal breeding recently secured is a hulless oat from Swedish Select and Kilby Hulless. This is named Fowlds oat, after its originator, by his associates in the department. The story of the development of this oat is an exceedingly interesting one and hopefully will be published as a contribution to the knowledge of the technique of cereal breeding. Practically, this hulless oat gives promise of being a somewhat higher yielder than other hulless varieties and like such varieties it will find its utility as a feed for young and growing animals.

Numerous other hybrids are in progress of development by Mr. Fowlds. It is hoped that certain selections of wheat

may prove resistant of rust and scab and likewise, of high class milling quality. Some of the cereal hybrids, thus partially developed are as follows:

Swedish Select × Hulless oats.
Sixty Day × Hulless oats.
White Russian × Hulless oats.

Some progress in the development of rust resistance in cereals has been made not only by the development of rust resistant varieties, such as Kubanka and Acme (Durum wheats), but also by the use of early maturing varieties, e. g., Sixty Day oats and Cole oats.

One of the most immediate needs of the agronomy department is that of funds to be devoted to crop improvement. No state offers a more fruitful field for development of crops, not only cereals, but forage crops, including alfalfa. Thousands of calls come to South Dakota farmers and seed producers annually for improved strains of pure seed. These farmers look to our experiment station and to the agronomy department not only for supplies of such seed, but also for information concerning which strains are more profitable. At the present time our nursery work in cereal breeding is seriously undermanned. An addition of funds would enable the department first, to make vital improvements in the quality of our present productions and, second, to enlarge the scope of fundamental research.

The following bulletins have been published during the fiscal year:

No. 200. Winter Wheat in South Dakota.
No. 201. Some Experiments with Spring Wheat in South Dakota.

Very respectfully,
(Signed) A. N. HUME,
Agronomist and Supt. of Substations.

DEPARTMENT OF CHEMISTRY

J. W. Wilson, Director.
Experiment Station.
Dear Sir:

The following is submitted as a brief resume of the work of the division of chemistry for the year ended June 30th, last past:

This division has cooperated, as in former years, with the division of animal husbandry, in running analyses of silage in connection with their project covering examination of different silages.

We have also continued our work in cooperation with the dairy division, by way of analytical work parallel with the investigations of Professor Olson into the value of varied feeding materials in relation to the presence of vitamine content in milk produced through such feedings.

We have initiated a new project in this division, which has to do with the investigation of plant food materials which are built into the production of various farm crops, beginning our work with barley. Our plan is to find, if possible, just what amounts of the several usually acknowledged foods are used in growth, as well as to determine, later on in the work, whether our usual and official methods of analysis account accurately for such essential foods, and what may be the minimum amounts of such foods consistent with healthy growth and normal production of seed. We propose to do this work through the employment of plant media of known composition. Our work along the line of this project will be largely control work during the present season.

Respectfully submitted,
(Signed) B. A. DUNBAR,
Chemist.

DEPARTMENT OF DAIRY HUSBANDRY

Director J. W. Wilson,
South Dakota Agricultural Experiment Station,
Brookings, South Dakota.

Dear Sir:

Pursuant to your request of recent date, I would submit the following report of the experimental work of the dairy husbandry department for the fiscal year ending June 30, 1923:

One of the most effective ways of being of service to agriculture and those engaged in it, is by doing good experimental work. If agriculture is to progress it must be on a sound scientific basis. These bases can only be determined by well thought out and carefully executed experiments. That these experiments should be practical and their findings of value to South Dakota dairy farmers is self evident. With this thought in mind regarding experimental work, the following projects have been under consideration during the past year:

Adams Project

Title—Relative value of wholemilk, skimmilk, and skimmilk powder for growth of cattle, and the best grains to

supplement each as indicated by the selections made by the various calves.

Object—The object of this experiment was to determine the relative feeding value of wholemilk, skimmilk and skimmilk powder, supplemented by grain and alfalfa hay ad libitum, when fed to dairy calves. Also to note the amount and kind of feed chosen by the calves at the different stages of their development, to supplement the milk part of the ration. To secure these data four calves were chosen, each having its own pen, and an individual feeder. The self-feeder was divided in six compartments, each compartment containing a different feed. The feeds used were whole yellow corn, whole oats, and alfalfa hay ad libitum. The feed in each compartment was weighed in whenever necessary. All the feed was weighed out of each compartment biweekly, and fresh feed put back. Hence, accurate data of all the feed consumed is available.

The calves were weighed and measured biweekly, in order that the growth curve made by the various calves could be checked with the normal growth curve of calves. It is planned to continue this experiment for another year, as a check and verification of the data secured.

The following conclusions have been deduced from daily observations and the data obtained:

1. Self feeders for calves are impracticable. The calves ate too much of the high priced protein feeds, and maintained themselves in too high a condition of flesh for economical growth.

2. Too little roughage was eaten. Although the roughage consisted of the choicest alfalfa hay, very little was eaten. Two calves showed very little barrel development, which can be attributed to the fact that very little roughage was eaten.

3. Although the calves remained in a good state of health throughout the experiment, one calf showed symptoms of grain founder. She seemed somewhat stiff and sore, and was lying down most of the time.

4. The experimental animals indicated no preference for yellow corn, in fact more of the white than yellow corn was eaten.

Hatch Fund

Prof. T. H. Wright had charge of the experiment on this fund. However, in as much as he has left the department, I am reporting on this fund for him.

Title—Pasteurization of market milk in the glass enamel tank and in-the-bottle.

The glass enamel tank is being used to a considerable

extent in the dairy industry. In view of this fact it seemed advisable to conduct an experiment to determine its practicability as a pasteurizer for market milk, considering its effect upon the bacterial count, cream line and flavor.

In as much as the in-the-bottle method of pasteurization was in use in the college creamery, it was thought that a comparison of this method with the pasteurization in the glass enamel vat would give data of practical value to the market milk industry as well as to the consumers of market milk.

The results of this experiment have been published in Bulletin No. 203.

Local Station

Soybean Meal vs. Oilmeal

Project No. 1—Soybean meal vs. Oilmeal for Milk and Fat Production. Livestock farmers have been advised and urged for some time to feed a balanced ration. This necessitates the purchase of protein feeds to supplement home grown grains. The protein feeds usually purchased were oilmeal, gluten meal, cottonseed meal, and bran. Frequently the purchase price of these feeds is relatively higher than the home grown grains and the farmers do not make the necessary purchase to supplement their home grown grain.

Soybeans can be grown for both seed and forage in South Dakota. Their feeding value is equal to that of other high protein feeds; the farmer can grow a balanced ration on his own farm and thus get away from the high priced commercial protein feeds.

The purpose of this experiment was, therefore, to secure accurate data on this point, Accordingly an experiment was outlined and carefully executed.

The data which will be published in bulletin form indicated that soybeans were somewhat higher in feeding value than oilmeal. On the basis of total pounds of nutri ents necessary for the production of 100 pounds of milk, soybeans were more valuable than oilmeal. The data indicated that when oilmeal is valued at $45 per ton, soybean meal is worth $58 per ton.

During the heavy buying season, oilmeal has ranged in price from $55 to $65 per ton. Soybeans, therefore, would be worth as feed for cattle $71 to $84 per ton. The data indicates conclusively that farmers can make money growing their own protein feeds, and thus decrease materially the cost of milk production.

The data secured on the quality of butter produced from feeding soybean meal also indicated no deleterious effects

when moderate amounts were fed. When too great a quantity is fed it produces a soft, salvy butter which might affect its commercial value. However, judicious and economical feeding would obviate this trouble, as it would not be advisable from these viewpoints to feed excessive amounts.

So far as appearance indicates health, and physical well being, the experimental animals showed no ill effect from the soybean meal. Their coats were as glossy and their condition of flesh as good as when oilmeal was fed.

Effect of Silage on Vitamin C Potency of Milk

Project 2—Feeding experiments of more recent years have been along lines to show the effect of various feeds on the quality and potency of the product produced from them.

Silage has long been regarded as a valuable roughage from the standpoint of the nutrients it contains, in addition to its succulent nature. This experiment attributes to it another, and even greater value.

Experimental work at the Wisconsin station a year or two ago indicated that silage did not increase the Vitamin C potency of milk. The silage which they fed was made from matured corn. The experiment cited under Project 2 of this department, was organized to prove whether the silage used in the college herd, which is in all essentials like the silage put up by the South Dakota farmers, did contain the Vitamin C, and would affect directly or indirectly the potency of the same vitamin in the milk.

Milk was secured from a dairy herd to which no silage or other succulent feeds were fed. The milk from this herd was fed to eight guinea pigs in the following amounts: Two pigs received 15 cc, two pigs 20cc, two pigs 30cc, one pig 45cc and one pig 60cc. Varying amounts were fed to determine the minimum amounts of milk required to prevent scurvy.

An equal number of pigs were fed corresponding amounts of milk from the college dairy herd, where silage was fed as a part of the dairy ration.

The feeds other than silage for the two herds, were about the same. The quality of the alfalfa fed to the farmer's herd was greener and of better quality than that fed to the college herd up to the last of February, after which time the quality of the dry roughage fed to the two herds was about the same.

Guinea pigs were used as test animals, because of all small animals they are the most susceptible to scurvy, which results from a lack of Vitamin C in the ration. Larger animals could be used, but their initial cost and their greater

resistance to the attack of any deficiency disease is such that their use adds materially to the cost of the experiment and yet does not enhance the value of the experimental data.

In brief, the results indicated that by feeding silage to dairy cows, the potency of the Vitamin C content in their milk is perpetuated, and possibly increased. Of the eight pigs fed milk from the farmer's herd, seven of them developed scurvy, and six of them died. The death of the seventh pig was prevented by feeding orange juice, which is known to be very high in the substance which prevents scurvy. Of the eight pigs which were on milk from the college herd, three pigs on 20, 20, 15cc respectively, developed scurvy symptoms and the one on 15cc of milk died.

It is of interest to know that the total milk solids were higher in the milk from the farmer's herd than the milk from the college herd, the former being 13.65 percent, the latter 12.61 percent. Inasmuch as the total solids of milk is an indication of its nutritive value, the milk from the farmers's herd should have produced the better results from the nutritive standpoint.

Practical feeders have long since recognized the improved condition of cows when silage is fed, and if the milk from silage fed cows is increased in Vitamin C potency, another important attribute for silage has been discovered.

Feed as a Factor in Economical Milk Production

Project No. 3—Much of the experimental work on feeds and feedings has been along lines which lead to a greater total milk production. The economy of milk production in so far as the feeds affect it, has not been duly considered.

Farmers and cost accounting workers have secured data which frequently indicate that from the viewpoint of economy of producing milk the farmer who feeds sparingly of grain receives the greatest net returns.

It is not possible for want of space to discuss here the many factors other than feeds which might tend to decrease the net income in milk production, but that those factors are important is recognized by all who have studied the factors operative in the cost of milk production.

This department received numerous inquiries regarding the kinds of feeds to purchase, and whether it is advisable from the standpoint of economy of milk production to feed protein feeds such as bran and oilmeal.

The experiment listed as Project No. 3 was organized to answer the following inquiries:

Is it good economy to purchase bran and oilmeal when alfalfa hay, silage, corn and oats are fed?

Is it advisable from the standpoint of economy in milk production to feed corn and oats, with good quality alfalfa hay and corn silage to all dairy cows?

To secure data which would answer as definitely as possible these questions, feeding trials were run with a number of cows in the college herd. The trials have continued for two years, comprising cows varying in milk yield, age and in stage of lactation. These cows were selected in order to secure data indicating the effect of the above factors on the kind of ration to feed.

The data indicates in general that farmers who have cows of average production or below cannot afford to purchase oilmeal and bran, at the prices which these feeds usually sell for, providing alfalfa hay and corn silage are fed. It is assumed that practical dairymen will provide these feeds first, hence these data do not make any attempt at answering what feeds to use when other roughages are fed.

Further, the data indicates that cows of low production will produce milk most economically on good quality alfalfa and silage without grain.

The data substantiated similar work from other stations regarding the economy of production of heavy producing cows. Those cows which can consume large amounts of feed over and above that required for maintenance and convert same into milk, can be fed liberally of high protein feeds, and yet show an increase over cost of feed.

It must be understood that these data are being discussed from the standpoint of cost of milk production only. There are other factors which would make grain feeding advisable even though the net income was decreased. Space will not permit a discussion of these factors.

The Breeding Up Experiment

Project No. 4—This work was started in 1907 to show the influence of purebred sires when mated with grade beef cows. One bulletin has been published on the data. The work is still in progress.

The importance of the purebred sire is too well recognized to require any confirmatory data, only to say that the data secured in this work put a premium on good sires.

Factors Affecting Milk Secretion

Project No. 5—A number of tests were conducted to gain more information regarding the process of milk secretion and the cause for the low percent of fat in the foremilk.

One hundred cc portions were drawn from each teat in rotation until the cow was milked dry. From each 100cc

portion a sample was taken and tested by the Babcock test.

These trials were conducted on four cows, one from each breed, under the following conditions:

1. As soon as the cows were put into the stable. Milking done with as little manipulation of the udder as possible.
2. After the cows have stood two hours, and the udder thoroughly massaged before milking.

The foremilk drawn from cows whose udders had not been manipulated showed a much lower percent of fat than the foremilk from cows just coming into the stable or when the udder was thoroughly massaged.

The data seemed to indicate that the fat rises to the surface of the milk in the milk cistern, or clings to the walls of the ducts and the alvioli. Agitation of the udder mixes the fat more completely with the milk, thus increasing the percent in the first drawn or foremilk.

Effect of High-Protein Feeds on the Percent of Fat in Cow's Milk

Project No. 6—The fact that the percent of fat in cow's milk is an inherited characteristic and cannot be increased by specific feeds, is well established. However, cows do react to certain feeds and other stimuli temporarily. High protein feeds have been regarded as a favorable stimuli to increased fat percentage.

Inasmuch as advanced registry testing is made on the basis of a two day official test, it is important to know whether certain feeds can be fed, the effects of which might cause an increase in fat for the two days when the official supervisor is present, thus increasing materially the production for the month, as the two day average is taken as the average for the entire month.

Of the high protein feed used, soybeans when fed in sufficient quantities did increase the percent of fat. With one cow this increase amounted to 15 percent. The increase in percent of fat continued for at least ten days with this particular animal. Whether the same animal would react in a like manner to succeeding feeds was not determined. The other high protein feeds used indicated no increase in percent of fat.

Respectfully submitted,

THOMAS M. OLSON.

DEPARTMENT OF ZOOLOGY-ENTOMOLOGY

Director James W. Wilson,
South Dakota Agricultural Experiment Station,
Brookings, South Dakota.

Dear Sir:

In reply to your recent request, I am submitting herewith a report of the experiment station work conducted by the zoology-entomology department during the fiscal year ending June 30, 1923. Two projects, both financed through Adams funds, were investigated. Project 3 was conducted under the leadership of H. C. Severin, while Project 4 was supervised by George I. Gilbertson.

Adams Project 11

Title: Distribution, life history, economic importance, natural enemies and control of the common field cricket **(Gryllus assimilis Fab.)**

During the past fiscal year, our experiment work with this project consisted chiefly in an attempt to discover the most effective poisoned bait which would kill off this species of cricket in any of its nymphal stages, and also in its adult form. After trying out baits made according to many dozen different formulae, we concluded that the bait that was most effective and most economical to use was one made according to the following formula:

Bran—25 lbs.
White arsenic or Paris green—1½ lbs.
Black strap molasses—1 gallon.
Water—3¾ gallons.

The time of day when this bait should be applied to infested land is after 6 p. m. on hot sunshiny days and after 4 p. m. on cool cloudy days. The bait should be broadcast over the entire infested areas, four pounds of the dry bran being sufficient to cover one acre. In alfalfa fields, it is advisable to distribute the bait after the first cutting of hay has been removed. In sections of the state where alfalfa is irrigated, the cut-over alfalfa should be irrigated before the poisoned bait is applied, while in those sections where irrigation is not practiced, the bait should be applied to the field after a heavy rain has fallen. In all of our poisoning work we have found that one application of the bait mentioned killed at least 50 percent of the crickets. Because of the fact that grasshoppers, crickets and ants carry away or devour weak and dead crickets, and because of the fact that many of the poisoned crickets crawled into cracks and crev-

ices to die, our estimate of the efficiency of this bait is probably too low.

Considerable progress during the past year was also made in getting ready drawings and photographs that are to be used in illustrating the life cycle of this injurious insect.

Adams Project 4

Title: The wheat stem maggot **(Meromyza americana Fitch)**, its distribution, food plants, economic importance, life history, habits, natural enemies and control.

As stated in my last report, the bibliographic work of this project has now been carried on to completion.

The various lines of life history work of this pest which have engaged our attention and study during the past biennium are now being gradually brought to a definite conclusion. The following phases of the life history have been completed:

a—First appearance of adult
b—Maximum appearance of adult
c—Longevity of adult
d—Mating
e—Pre-oviposition period
f—Egg laying habits
g—Description of egg
h—Number of eggs laid
i —Duration of egg stage
j —Hatching of egg
k—Description of larval stage
l —Feeding habits of larvae
m—Host plants of larvae
n—Pupation
o—Description and position of pupae
p—Duration of pupal life
q—Emergence of fly

Ever since we have been working with this pest, the annual brood cycle has been studied and recorded. While this cycle varies somewhat with the seasonal and daily climatic variations, we are convinced that enough data has been accumulated which settles the life history of the pest under South Dakota conditions. This data has been gleaned from the following sources:

a—Systematic daily collections
b—Laboratory breeding work
c—Field breeding work

These three lines of work have presented us with the knowledge of the maximum appearance of the fly indicative

of the brood present at a particular date and with the diminishing numbers of the flies indicative of the end period of the brood. Even though the flies are present at all times, indicating an over-lapping of broods, still we have determined fairly accurately the appearance of the various broods throughout the season.

Our knowledge of the distribution of the wheat stem maggot over South Dakota has been added to during the past year by the collections of various members in the department. Names of new localities infested with Meromyza has increased our distributional data, as well as the percentage of injury and the host plants infested for each locality. Following is the list of cultivated and wild plants found to be attacked with this pest:

Wheat—

Marquis	Castilione
Preston	Black Don
Acme	Monad
Turkey	Pellis
Minbard	Mindum
Mintork	Arnautka
Prelude	Pierson 999
Kola	Disco
Pioneer	Kanred
Ruby	Kitchener
Station Red	Redbob
Kubanka	Redrock

Barley (both two and six rowed)
Oats
Rye (both spring and winter)
Emmer
Timothy
Quack grass (Agropyron repens L.)
Slender wheat grass (Agropyron tenerum Vasey)
Western wheat grass (Agropyron smithii Rydb.)
Wild barley (Hordeum jubatum L.)
Brome grass (Bromus secalinus L.)
Wild rye grass (Elymus sp ?)
Green foxtail grass (Setria viridis L.)
Yellow foxtail grass (Setaria glauca L.)

Considerable effort has been expended during the past year to determine exactly the role of parasitism in relation to the control of the wheat stem maggot. The natural enemies of the pest are as follows:

a—Coelinidea meromyza
b—Microbracon meromyza

c—Pediculoides ventricosus
d—Eurytoma sp.
e—Trombidium sp.
f—Fungus sp.

The two hymenopterous parasites, Coelinidea and Microbracon are still in the lead in economic importance. Of the parasites reared, the Coelinidea outnumbers the Microbracon. This past year, a new parasite has been reared, the Eurytoma species. Unfortunately, we have been able to rear only the males, and the Hymenoptera specialists in Washington were unable to determine the exact species from one sex alone. We hope in the future to establish the identity of this parasite and determine its economic importance.

This past year we have experimented still further with many poison baits for the control of the wheat stem maggot. We have discarded all but a few which hold promise for their economical and practical application. The work of the past year has proved to us, beyond a doubt, that light traps and hand picking over large and small areas is a failure. Considerable data has been accumulated giving the effect of various cultural and crop rotation methods upon the abundance of the wheat stem maggot.

We consider the work of this project practically at a close, and with this point in mind this past year, we have prepared the pen and ink drawings for the life history and injury which will go to the engravers for finishing this coming winter. This is also true of the photographs which we will use to illustrate the bulletin.

Very truly yours,

H. C. SEVERIN.

DEPARTMENT OF HORTICULTURE

Director James W. Wilson,
South Dakota Experiment Station,
Brookings, South Dakota.

Dear Sir:

The present season, 1923, is my twenty-ninth year of experiments in originating new fruits at this station. Much work also has been done in originating hardy roses, in introducing new plants from European Russia and Siberia, and in collecting plants from many parts of the Canadian northwest for future experiments.

In the spring of 1922, trees of the following new varieties were distributed for the first time: Kola crab, Tipi crab, Shoko crab, Zapta crab, Goldo apple, Linda Sweet crab, Maga crab, Oxbo apple, Zeleba apple, Siberian Black currant, Lemon apple, Select wild South Dakota gooseberries, also plants of six raspberries, Spineless, Fewthorn, Starlight, Smooth Can, Moonbeam, Twilight.

Anoka Apple

A most remarkable variety, the Anoka, has resulted from my work with over 10,000 apple seedlings along many lines of pedigree.

This is an apple that bears on one year old wood. It was first introduced in the spring of 1918 before fruiting as South Dakota No. 2. In the spring of 1922 it was given the name Anoka, a Sioux Indian word meaning "on both sides." It is a seedling of Mercer (Fluke) wild crab top-grafted on Duchess. This tree fruited heavily in 1918 and 1919. The fruit is two and one-half inches in diameter, round, Duchess type of coloring. Flesh white, good sub-acid. Season September. I am pleased with the early and continued heavy annual bearing of this variety under propagation. Many people who have sampled the fruit say the Anoka is better for eating out of the hand than the Duchess. Other favorable reports have been received indicating the strong early bearing habit of the Anoka apple. The original stock and young nursery trees at the South Dakota station all are very productive.

In the spring of 1920 four trees of Anoka apple, one year buds on seedlings of Red Siberian crab, were sent to the experiment station at Fargo, North Dakota. Under date of December 2, 1922, Professor A. F. Yeager, Agricultural College, Fargo, North Dakota, reports on these trees as follows: "This spring two of the four trees blossomed, one produced 23 apples, the other 26. Practically all the fruit

was set from lateral buds. Upon examination this fall it seems that all four of the Anoka apple trees have a lot of lateral fruit buds showing. The trees are not yet as high as one's head and were scarcely four feet high last spring. They began ripening about the 15th of August. The apples are medium to above medium in size, but somewhat larger than Duchess. They are oblong in character. Our specimens show very little color. The flavor seems to be very similar to Duchess. If the variety continues to flourish as it has so far it should be a big addition to our fruit list."

Taming the American Wild Crab Apple

The wild crab apple was the only apple known to the Indians before the white man brought over the cultivated apple which is a native of the temperate regions of Europe and Asia. The Indians cached or buried the fruit outdoors in the earth over winter. This served to tone down the astringency.

My chief hope in growing many thousands of apple and crab seedlings has been to tame the wild American crab apple enough so that the fruit would be desirable at least for culinary use. In the seedling plantations of this station the wild crab apple from Elk River, some forty miles northwest of Minneapolis, Minnesota, has proved hardy, productive and practically immune to blight. The abundant fragrant pink and white blossoms in the spring make the trees of great value for lawn and park planting, while the fruit is too sour and astringent to tempt anyone. However, the fruit will keep at least a year and is useful to impart a quince-like flavor to common apple sauce. In fact, some people consider wild American apples a fair substitute for quinces in making preserves.

While the following four varieties are by no means perfect, they are worthy of attention. In the language of the orator, we stand at the threshold of a new era. I have my lasso over the broncho's neck but he is not yet fully tamed. Soon I trust he will be eating right out of my hand. I believe these crab apples will prove hardy far north into Manitoba and will keep well into spring in an ordinary cellar. In the standard fruit lists for the northern limits of apple culture in the prairie northwest we must admit we have only summer and fall varieties, but no real winter apples that will keep into spring in an ordinary cellar. I believe that the future ideal winter apple must probably come about by totally new combination of unit characters.

Kola Crab

A hybrid of the wild native crab apple from Elk River, Minnesota, with pollen of Duchess of Oldenburg apple. The fruit is flat, green, full two inches in diameter on the original tree fruiting in greatly crowded nursery rows of seedlings. The skin is oily as in the wild crab. The fruit cooks up into an acceptable sauce. Trees have strong forks and appear immune to blight and winterkilling. Kola is the Sioux Indian name for "friend." The heaviest specimen of Kola in 1919 weighed three ounces; the largest was two and one-half inches in diameter. This was the first year of fruiting.

Tipi Crab

Also a hybrid of the wild crab of Elk River, Minnesota, with pollen of the Duchess of Oldenburg apple and much the same in tree and fruit as Kola. Tipi is the Teton Indian for "tent."

Shoko Crab

A hybrid of the wild crab of Elk River, Minnesota, with pollen of Alexander apple, one of the largest Russian apples. Fruit nearly two inches in diameter, green, acid, but cooking into acceptable sauce. The size of the fruit will probably increase, as the original tree is much crowded in nursery rows. Shoko is the Sioux Indian for "seven."

Zapta Crab

A hybrid of the wild native crab apple from Elk River, Minnesota, with pollen of the Bismarck apple, a large variety from New Zealand resembling the Alexander. Fruit two and one-eighth inches in diameter, green, acid and acerb, but cooks up well into sauce. The original tree is closely crowded in our seedling nursery so the size of the fruit will probably increase under propagation. Zapta is the Sioux Indian for "five."

Goldo Apple

A seedling of Grimes Golden top grafted on Duchess of Oldenburg apple. The name is condensed from these two varieties. Goldo is distinguished by the smooth, hardy, vigorous growth of the original tree. The fruit is much like Grimes Golden in general appearance and excellent flavor. If the trees prove hardy under propagation it will be a decided acquisition as a variety combining the hardiness of Duchess with the size and high quality of Grimes Golden.

Linda Sweet Crab

A seedling of Malinda apple top grafted on Sweet Russet crab apple. A large crab apple with skin much russeted.

Flesh mild, subacid, sweet. Apparently a late winter crab. The influence of the Sweet Russet pollen is evident from the sweet flesh and russet skin. Linda is derived from the word Malinda.

Maga Crab

A seedling of MacIntosh Red apple top grafted on Duchess of Oldenburg apple. The name is condensed from these two varieties. Fruit of fair size, up to two and five-eighths inches in diameter, white, juicy, subacid. Season probably late fall, but not fully determined. A stocky grower in nursery.

Zeleba Apple

Our own importation from Russia. The full name, Krimskaja Zeleba, indicates that the Crimea in southern Russia is the place of origin. As fruited here it is a very large round red apple, size about three and one-half inches in diameter, and very heavy, flesh white, pleasant subacid. The fruit cooks up well. An apple of very attractive color, really a beautiful fruit. Season about December to midwinter.

Lemon Apple

Limonoe (R. & K. 159) apple. A large apple, fully three inches in diameter; color, clear greenish yellow with bronze blush. Flesh white, mild subacid, of good quality. Shows some evidence of keeping capacity. Although not the first time the Lemon apple has been imported, this is our own importation from Russia. Worthy of a trial at the north.

Siberian Black Currant

Collected by N. E. Hansen in the Tomsk province of Siberia. Fruit of good size and plant perfectly hardy. The ordinary black currant is a native of western Europe where the fruit is highly prized for jelly and jams. But it does not do well in the prairie northwest. I believe this Siberian black currant will be hardy far north into northern Manitoba and Saskatchewan, Canada.

Select Wild South Dakota Gooseberries

The native gooseberry of this region (Ribes gracile) has been carried through seven plant generations. The eighth generation is now coming on. Many thousands of seedlings have been discarded. Some interesting hybrids with the immense gooseberries of western Europe have been obtained, but these are not yet ready for distribution. Meanwhile, we can spare this year some of the pure native seedlings; bushes vigorous, very productive; thorny; fruit large, up to or even

exceeding a half-inch in diameter, black, smooth, makes an excellent red sauce.

A Sweet Choke Cherry

W. J. Boughen, Valley River, Manitoba, found a tree of the native choke cherry on his farm with fruit so much milder in flavor than usual that it may fairly be called a sweet or chokeless choke cherry. Offered for the first time. Mr. Boughen has the first right to name this fruit, so we will await developments.

Tom Thumb Cherry

The following is from our 1916 spring list:

"The first step in my project of breeding plums true to seed to avoid the necessity of budding and grafting. T. T. Seed No. 1 is a seedling of Opata. T. T. Seed No. 2 is a seedling of Ezaptan which is of the same pedigree as Sapa. I am not sure this plan will be desirable as the trees would need to be isolated when in bloom, either by tenting the trees or by planting them far from other trees. Some of them will no doubt revert, others will come true. To complete this work, seedlings should be raised and only those saved that come true."

The following is from our 1921 spring list:

"We have not sent out trees of this series since, but have a few trees for spring of True to Seed No. 2. I have watched this seedling closely the past five years. It is practically a Sapa in fruit, but the plant is a low bush, having much the same habit as its granddam, the native sand cherry. Bears freely on one year shoots in nursery, from the ground up, and annually thereafter. But probably the plant should be propagated by layers to save the expense of budding. What has been done in this seedling is really to reduce the choice black-purple flesh plum-sand cherry hybrid to the stature of a small fruit. They can be planted close together like currant bushes. What more can be done, the future must disclose."

In the spring of 1922 I named this variety Tom Thumb cherry. I have good reports concerning this variety from various places at the far north in Canada and elsewhere.

May Day Tree

This bird cherry from eastern Siberia is worthy of a place on every lawn in the prairie northwest. It is remarkable for being the first tree to come into full leaf here on the college grounds. The large green leaves and wealth of white blossoms early in the spring make the tree decidedly ornamental. In fruit the tree is no special improvement over

our own native choke cherry, but is decidedly superior in habit because it does not send up sprouts or suckers. These seedlings are descended from the stock originally imported from Russia by Professor J. L. Budd under the name Prunus Maacki.

I am using these seedlings as a budding stock for the Boughen Manitoba sweet choke cherry because of its vigorous growth and freedom from suckers. More seedlings were distributed in the spring of 1923.

Breeding of Hardy Red Raspberries

The raspberries from eastern and southern states are not hardy for the northwestern prairies. Many years ago I began the work of growing thousands of seedlings of the red raspberry of South Dakota, North Dakota, Minnesota, Manitoba and Sasketchewan. The work is still going on, although greatly hampered in recent years for lack of land. With ten acres now available for next spring we hope to do more in this line in the future. By hybridizing with the standard cultivated varieties of raspberry a number of promising seedlings have appeared. The Sunbeam was the best in the first seven thousand seedlings, and the Ohta the best in the next six thousand. Both have become prominent over a large area. The object of this work is to develop red raspberries that will be hardy without winter protection. The following six varieties are offered with the same idea in mind. Therefore, they are not intended to compete with the larger fruited varieties that need to be protected by laying down the cane and covering with earth over winter. It may be that our future ideal hardy red raspberry will be derived exclusively from the pure native wild raspberry of the northwest, but my experience with many thousands of seedlings indicates that this will be a slow process. Meanwhile, these varieties will be useful.

Spineless Raspberry

A hybrid of the wild red raspberry from Cavalier, North Dakota, with pollen of Loudon red respberry. Remarkable for its thornless canes. Fruit is about three-fourths of an inch in diameter, of extra good flavor. The canes have a blue bloom with some red toward the tips. In our experiments in breeding raspberries free from cane rust (anthrachnose), this one is the most immune although not quite free.

Fewthorn Raspberry

A hybrid of the Minnesota Ironclad red raspberry with pollen of a wild red raspberry from the Black Hills, near Rapid City, South Dakota. Canes almost thornless, except

for a few weak bristles near the ground. Fruit of good size, five-eighths to three-quarters inch in diameter. Color is dark red. The main point about this variety is that the berries keep well. They are firm and shrivel rather than rot.

Starlight Raspberry

Of the same pedigree as Ohta, a hybrid of the wild red raspberry from Cavalier, North Dakota, with pollen of Minnetonka Ironclad. Canes with some thorns, but very little anthrachnose. One of our very largest fruited seedlings in 1920, averaging somewhat larger than Ohta, and equally bright in color.

Smooth Cane Raspberry

A hybrid of the wild red raspberry from the Black Hills at Rapid City, South Dakota, with pollen of the Minnetonka Ironclad red raspberry. Fruit round, three-fourths of an inch in diameter, quite firm. Plant strong and stocky; second in its resistance to cane rust (anthrachnose). The cane is thornless, the leaf stalks are slightly bristly.

Moonbeam Raspberry

A hybrid of the wild red raspberry from Cavalier, North Dakota, with pollen of one of our hybrids of the wild red raspberry from the Black Hills at Rapid City, South Dakota, with pollen of Shaffer, a purple cane raspberry from New York. This plant has a few thorns, although not as many as some of the other seedlings. Berries large, late and firm. Plant drawf in habit but stocky.

Twilight Raspberry

Grown from select mixed fruit from our large seedling plantation of the wild red raspberry of South Dakota, North Dakota, northern Minnesota, Manitoba and Saskatchewan, and their hybrids with standard cultivated varieties. Nearly all these seedlings were discarded but this one was saved, owing to the strong cane. Canes strong and stocky with some thorns but very little anthrachnose. The fruit averages larger than the King as fruited here; color, a good light red; quality good.

Progress in Rose Breeding

The breeding of roses is a project on the Hatch fund. During the blooming season several thousand rose blossoms were pollinated with pollen of tame roses along new lines of pedigree. A large amount of seed resulted from this work. Many thousands of seedlings have been produced in this department by crossing the wild and Siberian roses with tame roses. So far only one has been named, the Te-

tonkaha, which was introduced in the spring of 1912. This is a seedling of the wild prairie rose from Lake Tetonkaha, about eighteen miles northwest of this station, crossed with the pollen of the Siberian Rosa rugosa, so that it is a combination of at least three species. The flowers are fully three inches in diameter; the bush is perfectly hardy, flowering abundantly in June; about eighteen to twenty-five petals, deep rich pink; very fragrant; appears desirable for dwarf hedges or as an ornamental shrub. The habit is more upright and the flowers are less concealed by the foliage than in the pure Rosa rugosa. This Tetonkaha rose proves absolutely hardy and very desirable in many places even far north into Manitoba without winter protection. It is a very free bloomer. The plants are of strong growth and as they sprout freely it should not be necessary to propagate on tender commercial stocks or from cuttings.

The Tetonkaha rose has been crossed with the American Beauty and gives us a flower containing about fifty petals. This is now being propagated for distribution.

In the spring of 1923 an experimental rose plantation was started at Sioux Falls. On the twenty acres now available for spring of 1924 at Sioux Falls, the rose breeding work will be the chief feature, although much work with fruits is also contemplated.

Field Explorations

In the spring of 1922 I made a plant collecting tour to Manitoba and Saskatchewan, Canada, and collected much new material. The main points reached were Fort a la Corne on the Saskatchewan River, and Hudson Bay Junction, Saskatchewan. Before starting northward I visited an orchard at Williamsburg, southeastern Iowa, to collect apple pollen.

More Land Needed

The following is from my 1922 spring list:

"The Regents of Education have kindly granted ten acres more land beginning the coming spring, which will be a great help until the state legislature can do something more about it. But the need of more land is still acute. A few years ago the South Dakota legislature furnished for my experiments the largest fruit-breeding greenhouse in the world. This made possible the Hansen hybrid plums, such as Opata and Waneta, and a long list of other fruits. But now I need more land to keep up the good work. The state of South Dakota should have the largest fruit breeding farm in the world, because it is necessary to complete the work already planned and to provide for future growth. Such a

farm would insure the rapid development of an entirely hardy list of fruits for the prairie northwest. Will you help realize this, my hope?"

Appropriation for Additional Work

Last winter the state legislature appropriated $10,000 annually for the next two years, beginning July 1, 1923, for experimental work in horticulture. This will make possible a much needed extension of the work, including the planting of several experimental state orchards in various parts of the state.

In the spring of 1923 work on these experimental plantations was begun at Sioux Falls, Watertown, Aberdeen, Pierre and Philip. Work is also planned for at Yankton, Plankinton, Custer, Gary and Eureka. The local cooperation at these places makes possible the beginning of the work. The plan at these stations includes:

1. To test all the standard varieties.

2. To demonstrate the best systems of orchard management.

3. To test out many thousands of new seedlings which I am originating every year.

4. To establish stock orchards, especially for the Siberian wild blight-proof pears and wild apples, to grow hardy seedlings upon which to bud the new hybrids coming on.

This is planned to be a permanent proposition. There will be some income from the sale of the seedlings to nurserymen, also from the sale of fruit. Such plantations will be a very great aid to true progress in horticulture for the prairie northwest.

Yours truly,

N. E. HANSEN,
Horticulturist.

DEPARTMENT OF VETERINARY

Director J. W. Wilson,
College.

Dear Sir:

I am handing you herewith a brief report of the work on hemorrhagic septicemia conducted by this department on Adams fund during the last fiscal year. No attempt was made to give detailed tables, or results of the work, but rather to report that work has been done, and to prepare the way for a more complete report and interpretation of results next year.

The wide prevalence of a disease of cattle, sheep and fowls in many parts of South Dakota, known as hemorrhagic septicemia, and various other common and often local names, has been the cause of considerable annual loss. This disease often appears quite suddenly, the organisms causing it show varying degrees of virulence, and in many instances, especially in cattle, it often ceases as suddenly as it began. The use of bacterins for vaccinating as a means of prevention in herds and flocks has become a quite general practice, but the protection thus afforded is of temporary duration. The bacteria causing hemorrhagic septicemia vary widely in their disease-producing properties and their pathogenicity for laboratory animals. All these facts together with various others make a further investigation of this disease desirable, with the ultimate object of suggesting a better and more lasting means of prevention.

The bacteria causing hemorrhagic septicemia are widely distributed in nature. They are to be found in stables and feed lots, and in fact in all locations on farms where animals and fowls are kept, but as a rule in an avirulent form, that is, with vitality sufficiently lowered to make their production of disease difficult, if not entirely impossible under ordinary conditions of animal health. These bacteria belong to a large family of organisms, all members of which have certain characteristics in common, but each member of which possesses certain peculiarities which distinguish it from the other members of the family. Thus one member of the family produces disease in cattle only and is known as the bovisepticus strain. Another produces disease in chickens only, the so-called chicken cholera, and is known as the avisepticus strain. The strain that produced disease in sheep is known as the ovisepticus strain. Still other strains are pathogenic for other species of animals and fowls, and present knowledge indicates that any one strain is not pathogenic for any but its own species under ordinary

conditions. Thus the cattle strain does not produce disease in fowls, or sheep, even though the microscopic and cultural characteristics of the strains are indistinguishable.

The work here reported was prosecuted during the past fiscal year. Approximately two-thirds the time of a laboratory assistant was required, the funds for which were derived from federal appropriation known as Adams fund. Eleven strains of bovisepticus, twenty strains of avisepticus and four strains of ovisepticus were examined in this work. Each strain was isolated in pure culture from material sent the Animal Health Laboratory of South Dakota State College for diagnosis. Each strain was tested for the production of acid and gas on thirteen rare sugars, the reactions on five of which have been studied before. Each strain was also tested for indol production, for its motility, and for its ability to break up red blood corpuscles and liberate the coloring matter known as hemoglobin. The pathogenic or disease-producing properties of the various strains were studied by injecting a measured quantity of a twenty-four hour broth culture into rabbits and white mice, both species of which are considered highly susceptible to the hemorrhagic septicemia organisms. When death occurred the laboratory animals were examined, and the organisms again recovered in pure culture.

The preceding paragraphs contain an outline of the prevalence and economic importance of hemorrhagic septicemia, and the reasons for engaging in its further study. Information was also included indicating the general trend of the investigation. Inasmuch as the problem is large and the work is only fairly under way, it seems unwise to attempt to interpret the results or to make practical applications of them at this time. The work will be continued during the present year, at the end of which it is hoped a more complete report can be made, including, if possible, at least a partial application of the results to disease conditions in this state.

Yours truly,

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